

Laboratory Measurements of the X-ray properties of the Fe K-alpha forest

Completed Technology Project (2015 - 2018)



Project Introduction

X-ray emission following K-shell transitions in iron ions has been detected in a plethora of celestial sources including Super Nova remnants, X-ray binaries, and the accretion disks surrounding black holes. Much of the emission is produced by the reprocessing of the bright, hard X-ray continuum from a central source or compact object, resulting in diagnostic-rich emission and absorption spectral features. Unfortunately, the diagnostic power of these features has not been fully realized. One limiting factor is our understanding of the underlying atomic physics that governs the absorption of the incident X-ray flux. Although many computer-based atomic spectral models have been developed, very little targeted, systematic laboratory measurements have been completed leaving the spectral models largely untested. This is especially true in the case of complex multi-electron ions with more than 16 bound electrons, i.e., charge states of iron above Fe16+, and other iron group elements, such as chromium, manganese and nickel. We propose to measure the electron impact excitation, photo excitation, and photoabsorption properties of multi-electron ions of iron group elements to high accuracy. The results will be used to benchmark atomic spectral models and to interpret spectra from astrophysical X-ray sources. The measurements will be carried out using the EBIT-I electron beam ion trap at LLNL and the portable FLASH EBIT coupled to 3rd and 4th generation advanced light sources, such as Desy's Petra-III synchrotron. Our measurements will take advantage of our group's successful work already conducted at these facilities. The results will be used immediately by the X-ray astrophysics community to interpret Fe K-shell spectra measured by the Chandra and XMM-Newton X-ray Observatories, and will prove invaluable in the analysis of high resolution Fe K spectra measured by the Soft X-ray Spectrometer (SXS) calorimeter to be launched on the Astro-H X-ray Observatory in 2015.



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

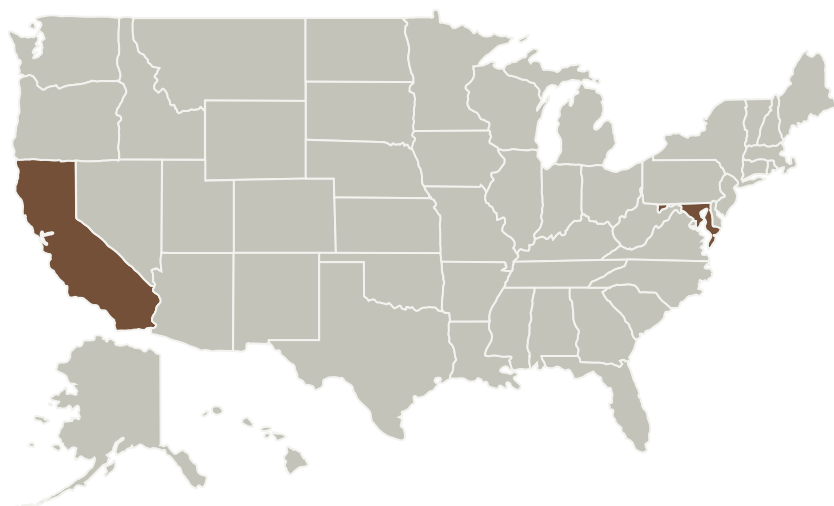
Astrophysics Research and Analysis

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Lawrence Livermore National Laboratory(LLNL)	Supporting Organization	R&D Center	Livermore, California

Primary U.S. Work Locations	
California	Maryland

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Gregory V Brown

Co-Investigators:

Maurice A Leutenegger

Richard L Kelley

Peter Beiersdorfer

Caroline A Kilbourne

Frederick S Porter

Ming F Gu

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.3 In-Situ Instruments and Sensors
 - └ TX08.3.1 Field and Particle Detectors

Target Destination

Outside the Solar System